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Knowledge Transfer Statement:

The present study can be used by dentists, community health workers, and policy makers in Indonesia to understand the prevalence, severity, and extent of the negative impacts of periodontal disease on older people's quality of life. In addition to this, this study also provides information about the relationship between other factors (brushing habits, dental visit, family income, DMF-T status, and subjective appraisal toward dental health) which might also considerably affect the OHRQoL in this society.

Abstract

Introduction: Despite acknowledged as the second global burden of oral disease, fewer epidemiological studies of periodontal disease in the literature, particularly for developing countries. Many of previous studies assessing the relationship between periodontal disease and oral health-related quality of life (OHRQoL) with patients attending dental clinic or hospitals rather than a general population. This study attempted to fill the knowledge gap in limited information about periodontal disease and OHRQoL, with specific reference to a general population in a developing country.

Objectives: To investigate the relationship between OHRQoL and periodontal diseases in the older population in Indonesia.

Methods: We invited 582 older people from community health centres. The 369 (63.4% of) older people who agreed to participate consented to both an oral health examination and questionnaire completion capturing demographic, socio-economic, behavioural, and Oral Health Impact Profile-14 (OHIP-14) data.

Results: Almost 75% of the older people had generalised periodontitis, 3% had a healthy periodontal, and around 22% had localised periodontitis. There was a lack of statistical evidence for an association between periodontal disease status and OHRQoL. This result was based on the appraisal of the prevalence of the impact (p =0.77, OR =0.95 (95%CI: (0.54, 1.59))), difference in mean severities (0.07, 95%CI: (-1.66, 1.80), p =0.94), and extent of the impact (p =0.996) assessment. However, we found evidence for a relationship between tooth mobility and OHRQoL for all of the OHIP assessments, including prevalence of the impact (p = 0.009, OR = 1.87 (95%CI: (1.16, 3.01))), difference in mean severities (-2.98, 95%CI: (-4.50, -1.45), $p < 0.001$), and extent of the impact (p =0.001).

Conclusion: There was a lack of statistical evidence for a relationship between periodontal disease status and OHRQoL in this society. However, we found evidence that tooth mobility, as a sign of periodontal disease progression is related to OHRQoL.

Introduction

Improvements in health prevention and treatment of diseases have contributed to a steadily increasing life expectancy. Correspondingly, the proportion of older people has been increasing around the world (United Nations 2017). This increased life expectancy is associated with challenges for global public health in relation to the burden of chronic non-communicable diseases (NCDs), which often reduce the oral health-related quality of life (OHRQoL) of older people (Newman et al. 2019).

Periodontal disease has been acknowledged as the second most important global oral disease burden after dental caries (Petersen and Ogawa 2012). Moreover, periodontal disease was the 7th most prevalent NCD worldwide (Vos et al. 2017).

Alongside dental caries, chronic periodontitis is the leading cause of tooth loss for adults globally (Jin et al. 2011; Jin et al. 2016; Pihlstrom et al. 2005). Individuals with advanced progression of periodontal disease are estimated to have a higher risk of losing multiple teeth, which may lead to problems with masticatory function, social-interactions, and self-esteem. This disease may also introduce burdens in socioeconomic impacts and oral health care costs (Chapple 2014; Jin et al. 2016; Petersen and Ogawa 2012; Tonetti et al. 2017).

Previous periodontal disease studies have mainly focused on objective evaluations based on the clinical and radiographic examinations. There was limited exploration regarding the subjective evaluations of the periodontal disease impact on the OHRQoL (Ferreira et al. 2017). Few previous studies assessing the relationship between periodontal disease and OHRQoL in a population setting as many of these studies performed the data collection with patients attending dental clinic or hospitals. Also, previous studies were mainly conducted in high and upper-middle-income countries. Thus, there is a need to investigate the relationship between periodontal disease and OHRQoL with lower-middle and low-income countries as research backgrounds (Masood et al. 2019). Another important gap is the evaluation of the relationship between periodontal disease and OHRQoL were often did not take into account other oral health diseases and systemic diseases which might potentially affect the relationship (Haag et al. 2017). FDI World Dental Federation also emphasizes the importance of socio-economic aspects and demographic factors in OHRQoL assessment (Hescot 2017).

Indonesia is a developing economy country and the fourth most populous country in the world. As with many other developing countries in Asia, Indonesia has witnessed population ageing and a growing number of older people. Up to the present time, there is limited information

regarding periodontal disease in Indonesia (Badan Penelitian dan Pengembangan Kesehatan 2019).

This study attempted to fill the gap of knowledge in limited information about the relationship between OHRQoL and periodontal disease, with Indonesia as a research background.

Methods

Ethical approval for this study was obtained from the Ethics Committee of Faculty Dentistry, Universitas Indonesia (ref:138/Ethical Approval/FKGUI/XI/2017). All the participants who participated had provided written informed consent.

This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for a cross-sectional study. This research focuses on the urban older population in three districts of Depok (Beji, Pancoran Mas, and Sukmajaya), Indonesia. Prior to the data collection of this study (February to May 2018), there was no published prevalence of periodontal disease in Indonesia (Badan Penelitian dan Pengembangan Kesehatan 2019). Thus, this study used the probability of periodontitis in the age group 65-year-old and above in Malaysia as an estimation for sample size calculation, which was 63% (probing depth ≥ 4mm) (World Health Organization 2010). Based on the simplified sample size calculation for sample survey, this study needed to obtained data from at least 359 participants (if P=0.63, confidence level 95%, and relative precision 5%).

The community health workers invited 582 (63.2% women and 36.8 percent men) older people registered with 12 elderly community health centres (*posbindu*). The participation response rate of this study was 63.4 percent, which means 369 (68.6% women and 31.4% men) people agreed to participate. There was less proportion of the men agreed to take part in the study than the men in the reference population, this might be caused by some of them were still working and did not have time available to participate in this study.

From the 369 participants, six participants were excluded from the analysis because of edentulism. Subjects were accepted as participants if they could meet the inclusion criteria: participants were native Indonesian of age 51 years old and above, able to provide consent, and had at least one natural tooth in mouth.

A questionnaire and oral health examination were used as the data collection instruments. The questionnaire involved questions about participants' background information, smoking and tobacco use status, diabetes status, oral health behaviour, a pattern of dental attendance, and

participants' perception regarding their oral health. In addition, the OHIP-14 was included in the questionnaire to assess OHRQoL.

Participants were asked about how frequently they had experienced a negative impact of their oral health problems on their well-being within a period of 12 months. Participants were required to give an answer for each impact in seven OHIP dimensions (functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap) based on a five-point Likert scale, coded: never (0), hardly ever (1), occasionally (2), fairly often(3), and very often (4) (Slade 1997).

In calculating the scoring formats of the OHIP as the primary outcomes, three estimations were calculated (prevalence, extent, and severity of the impact) (Tsakos et al. 2012). The details of the primary outcomes are presented in the Appendix. The minimal important difference (MID) for the OHIP-14 severity scores assessment is described as 5-scale points (Locker et al. 2004).

The Basic Periodontal Examination (BPE) to signify participants' periodontal disease was divided into two groups, participants who did not have generalised periodontitis and participants who had generalised periodontitis. The threshold for generalised periodontitis was defined as participants who have 30 percent or more of their remaining teeth affected by periodontitis (probing depth 3.5 mm or more) (British Society of Periodontology and Implant Dentistry 2018).

Oher intraoral health examination scales include Decayed, Missing and Filled Teeth Index (DMF-T) (World Health Organization 2013), Simplified Oral Hygiene Index (OHI-S) (World Health Organization 2013), tooth mobility status (Scottish Dental Clinical Effectiveness Programme 2014), and furcation involvement status (Newman et al. 2019). The details about calibration between dental examiners, the oral examinations, and categorisations used in this study are presented in the Appendix.

Statistical methodology

Descriptive statistics were calculated to estimate the characteristics of the study population, and the outcomes variables (prevalence, severity, and extent of the impact based on the OHIP-14 data). For exploration of continuous data (the severity of the impact), Normality testing included examination of histograms and Q-Q plots, Shapiro-Wilks and Kolmogorov-Smirnov tests, while Levene's test was used to assess equality of variances.

The independent samples t-test and the one-way analysis of variance (ANOVA)/Kruskal-Wallis were used to analyse the severity of impact according to the predictor variables

(demographic, socioeconomic, behavioural and systemic disease, subjective appraisal about oral health, and oral health condition). The independent t-test was performed where there were two groups of the independent variables. Dependent variable residuals normality in each group of the independent variables were checked before performing the one-way analysis of variance (ANOVA) or Kruskal-Wallis test. An ANOVA test was performed when there were more than two groups of the independent variables, evidence of the residuals normality distribution, and no evidence of a violation to homogeneity of variance assumptions. Kruskal-Wallis test was performed when there were more than two groups and there were evidence of violation to the residuals normality distribution.

To examine the relationship between prevalence of impact and a) periodontal condition (periodontal status, mobility status, and furcation status) and b) each of the seven domains of OHIP, separately, the Pearson chi-square test or Fisher's Exact test were performed and a corresponding odds ratio (OR) and 95% CI were calculated. Fisher's Exact test was used when cells have expected frequencies of less than 5.

For exploration of extent of impact, general assumptions of the non-parametric tests were checked before performing the non-parametric tests. The Mann-Whitney U test and Kruskal-Wallis test were used to analyse the extent of impact score according to the predictor variables. The Mann-Whitney U test was performed to test for differences in the extent of impact score between two groups of a categorical variable. The Kruskal-Wallis test was performed to test for differences of the extent of impact score between three or more groups of categorical variable.

In addition, a Jonckheere-Terpstra test for ordered alternatives was conducted to determine if there was a statistically significant trend between the independent variables and the extent of impact score. For non-parametric testing, the effect size proposed by Rosenthal calculation (Rosenthal's *r*) for Mann-Whitney U test and eta-squared calculation for Kruskal Wallis test were used. The interpretation of this effect size was based on Cohen's work on effect sizes for the non-parametric tests, using the classification ($r \leq 0.1$): small to medium effect size, ($0.1 < r \leq 0.3$): medium to large effect size, ($0.3 < r \leq 0.5$): large effect size ($r > 0.5$) (Pallant 2016).

Robust regression was carried out to determine the adjusted effect of each predictor variable on the total OHIP-14 scores (severity of the impact) as our data violated the assumption of normality and homoscedasticity. Model 1 examined the strength of the relationship between periodontal condition variables (periodontal status, mobility status, and furcation status) and the OHIP-14 scores. Model 2 included model 1 and additionally adjusted for age, gender, marital status, education, income, smoking status, brushing habits, pattern of dental visit,

diabetes status, diabetes time duration, and subjective appraisal of dental health. Finally, model 3 was additionally controlled for other oral health assessments (DMF-T score and OHI-S). Collinearity diagnostics were performed before running the regression model. The bootstrapped confidence intervals and significance values were reported as they did not rely on assumptions of normality and homoscedasticity.

Results

Our study found that almost 75 percent of the older people had generalised periodontitis and of the remaining participants, around 22 percent had localised periodontitis and almost 3 percent had a healthy periodontal condition. The mean number of teeth present in the sample of this study was 19.36 (SD = 7.02).

Summary data of the characteristics of the sample are presented in Table 1. The characteristics of the prevalence, severity, and extent of the impacts for each OHIP-14 dimension is presented in Appendix Table 1.

Periodontal disease and prevalence of the impact.

While prevalence of impact was not significantly associated with periodontal disease and furcation status, it was significantly associated with teeth mobility status, which is a recognized periodontal disease manifestation. Older people who had teeth with increased mobility were more likely to experience impact on their OHRQoL, with the odds ratio being almost two times than older people who did not have any teeth with increased mobility (Table 2). This result is explained further by five domains of the OHIP (functional limitations, physical pain, psychological discomfort, physical disability, and handicap), which were significantly associated with subjects' teeth mobility status (Appendix Table 2).

The severity of the impact

The severity of the impact differed significantly according to the brushing habits, DMF-T, teeth mobility, and subjective appraisal of dental health (Table 3).

Pairwise comparisons between categories of the subjective appraisal of dental health variable with Bonferroni corrections for multiple tests showed a statistically significant difference between those participants categorised as "Very good and good" and "Fair" (p <0.001, r = -

0.29) and between those categorised as “Very good and good” and “Bad and very bad” (p = 0.034, r = -0.18).

A Jonckheere-Terpstra test for ordered alternatives showed that there was a statistically significant increasing trend in severity of impact score with worse levels of subjective appraisal of dental condition, ($p < 0.001$).

The extent of the impact

The extent of impact differed significantly according to family income, brushing habits, pattern of the dental visit, subjective appraisal of dental health, DMF-T, furcation involvement, and mobility status (Table 4).

Pairwise comparison between categories of subjective appraisal of dental condition showed a statistically significant difference of the extent of impact score between the categories “Very good and good” and “Fair” ($p < 0.001$) and also between the categories “Very good and good” and “Bad and very bad” ($p = 0.004$).

A Jonckheere-Terpstra test for ordered alternatives showed that there was a statistically significant increasing trend in extent of impact scores with worse levels of subjective appraisal of dental condition ($p < 0.001$).

Multiple regression models of predictors variables on the total OHIP-14 score

The results from the multiple regression model (Table 5) show that the severity of the impact was significantly associated with teeth mobility status, DMF-T, and subjective appraisal in the fully adjusted model. The model explained 16.4% variability of the severity of the impact (R-square = 0.164). Teeth mobility status, as one of periodontal condition variables, showed a significant association with the severity of the impact. This relationship was attenuated but remained significant after further adjustment for demographic, socioeconomic, behavioural, systemic disease, subjective appraisal about oral health, and other oral health assessment (p-value = 0.002 (model 1); p-value = 0.005 (model 2); p-value = 0.01 (model 3)). Collinearity diagnostics indicates there is no collinearity issue within our data.

Discussion

In this study, the four dimensions of the OHIP which most commonly fell under the highest prevalence of impact were psychological discomfort (57.3%), functional limitation (37.2%), physical pain (28.7%), and physical disability (26.4%). This is consistent with a national survey

of the Canadian adult population, where psychological discomfort (11.3%), physical pain (9.3%), psychological disability (6.1%) and physical disability (5.4%) were the four most reported dimensions that affected OHRQoL (Locker and Quiñonez 2009). By comparison, a cross-sectional study of 20-64 year-olds in Brazil found psychological discomfort (35.8%), physical pain (19.6%), psychological disability (19.4%) and physical disability (17.0%) as the most reported impacts (Batista et al. 2014). A birth cohort study of 32-years conducted in New Zealand accounted physical disability (10.7%) and psychological disability (10.3%) as the most reported OHIP dimensions (Lawrence et al. 2008). Interestingly, our findings of the most reported impacts of OHIP's dimensions are considerably high in comparison with the previous studies above. Another difference from the earlier studies is our findings marked functional limitation as one of the dimensions with a high prevalence. These discrepancies might be due to differences in sample characteristics, including age ranges. This study focuses on older people of age 50 years and above. For this age group, oral health problems and high numbers of missing teeth may be more prevalent, leading to more oral health functional problems.

This study and a number of previous studies have reported a discrepancy between the periodontal clinical findings and OHRQoL assessed through the OHIP-14 (Kato et al. 2018; Khalifa et al. 2013; Lawal et al. 2014; Mariño et al. 2008; Montero-Martin et al. 2009; Sanadhya et al. 2015). Some of the comparable previous studies focused on developing countries (India, Nigeria, and Sudan) and some others on developed countries (Sweden, Spain, and Australia). Most of the previous studies, which confirmed an association between periodontal disease and OHRQoL were focused on developed countries (Sweden (Jansson et al. 2014), German (Brauchle et al. 2013) and United Kingdom (Bernabé and Marcenes 2010; Jowett et al. 2009; White et al. 2012)), an exception being a Brazilian study (Palma et al. 2013). The differences between study findings might be influenced by differing subjective perceptions, expectations, preferences, income social, psychological state, and psychological support (Tsakos et al. 2006).

Another consideration is the periodontal disease categorisation used in this study. Almost all of the participants in the study presented teeth affected by periodontitis; 97 percent of the participants had one or more teeth with probing pocket depth 3.5 mm or more. The high prevalence of periodontal disease might be due to the BPE examination as a sole indication to determine the periodontal disease. For comparative purposes, we divided respondents into two groups according to presence or absence of chronic generalised periodontitis. Based on this classification, some of the participants might have had missing teeth due to generalised periodontitis in the past which was not accounted for in our study. Consequently, through

focusing on existing rather than historical periodontal data for participants, we may have underestimated the extent of chronic periodontitis in the past in some cases and in turn, a potential association between periodontal disease status and OHRQoL. Another point of interest was the higher prevalence of periodontal disease found in this study (97%) than the national prevalence of periodontal disease of age group 45 years and above (77.8%) may affect the true relationship between periodontal disease and OHRQoL (Badan Penelitian dan Pengembangan Kesehatan 2019). This high prevalence of periodontal disease in the sample has introduced unequal sample distribution between older people who did not have generalised periodontitis and those who had generalised periodontitis (ratio 1:3), which may have reduced statistical power on comparing across groups.

While we did not identify a significant association between periodontal disease status and OHRQoL, we found a significant relationship between tooth mobility and OHRQoL. For all three estimates of OHIP, there was a highly significant relationship between tooth mobility and OHRQoL.

While there was a highly significant difference in the severity of impact according to tooth mobility status, the difference did not reach the MID threshold. However, we need to highlight that the MID threshold was established based on the longitudinal study, while our study is a cross-sectional study. There are none of the previous works reported the MID for a cross-sectional study with a non-normal distribution of the OHIP scores up to the present time. Nevertheless, there was strong evidence of the relationship shown by the prevalence and extent of the impacts assessments. In this case, older people with increased teeth mobility were 1.87 times more likely to experience negative impacts on their OHRQoL compared to those who did not have teeth with increased mobility. The multiple regression model also confirms a significant relationship between teeth mobility and severity of the impact on OHRQoL after adjustment for other predictors.

The discrepancy of the association between periodontal disease toward OHRQoL may be understood by the nature of periodontal disease as a chronic disease. This chronic disease may not show significant symptoms until it progresses to a later stage and creates obvious symptoms, such as tooth mobility (Petersen and Ogawa 2012).

There was no statistically significant relationship between the furcation status and prevalence of impacts. The p-value for the difference in mean severity of impact on the OHRQoL according to furcation status was slightly above the statistical significance level ($p = 0.054$). However, there was a statistically significant difference in extent of impact according to furcation status. Literature search regarding the association between furcation involvement and

OHRQoL through the MEDLINE database with keywords “furcation” and “quality of life” was done to compare this study’s findings with the previous studies. There were no previous studies which assessed this relationship up until data accessed on 11/01/2021.

This study also attempted to assess the relationship between OHRQoL and other predictors. The assessment was based on OHIP severity and extent of impact as outcome measurements.

None of the demographic variables and systemic disease variables showed a significant relationship with the OHRQoL. Previous study has reported that periodontal disease is significantly associated with type-2 diabetes (Chapple 2014). Although poorly controlled diabetes mellitus has been established as one of the important factors which related to periodontal health, the diabetes status and diabetes time duration variables in this study did not show any significant relationship with the OHRQoL.

The behavioural variables in this study comprised of brushing habits, smoking status, and pattern of dental visits. Severity of impact was found to be significantly different according to brushing habit. While extent of impact was also found to be significantly different according to each brushing habits and pattern of visit. These results were expected as better oral health maintenance can help people to maintain oral health.

Previous studies have demonstrated that the prevalence of pocket depth, attachment loss, and alveolar bone loss was higher in smokers compared to non-smokers (Johnson and Guthmiller 2007; Johnson and Hill 2004). Surprisingly, while smoking status is recognized as one of the important risk factors for periodontal disease, no significant difference was found in severity or extent of impact according to smoking status. The proportions of former and current smokers in our sample were quite low, approximately 14% and 10%, respectively which may have reduced statistical power on comparing across groups. As might be expected, the mean score of the severity of the impact was reported higher in both former smoker and current smoker compared to those who had never smoked. However, the differences were small, and did not achieve statistical significance.

Older people who had a routine dental check-up at least once a year reported being affected by less OHRQoL dimensions than those who did not have any routine dental check-up. Regular dental visits should allow dentist to detect oral health problems earlier and treat diseases before they progress to an advanced stage, which may impact OHRQoL.

Socioeconomic factors examined in this study included educational background and family income. The severity and extent of the impact did not differ significantly according to the educational background. A significant difference emerged for extent of impact according to family income.

This study also assessed the relationship between OHRQoL and other oral health predictors, including DMF-T and OHI-S. For each of severity and extent of impact there was a highly significant difference according to DMF-T.

Neither severity nor extent of impacts assessment were found to be statistically significant according to the OHI-S score. The OHI-S score was calculated as the mean of the debris and calculus scores from the present teeth. In the event that a participant did not have molars or incisors for one or more of the six segments measured for the OHI-S score, those segments were excluded from the calculation. Such participants might had experienced impacts on their OHRQoL due to tooth loss, and their OHI-S score could had been relatively low, given that the missing teeth had not been reflected in this score. This may help to explain why we did not find a significant relationship between OHI-S and OHRQoL. This possibility is supported by our data. Participants with better oral hygiene had more missing teeth; good hygiene: mean number of missing teeth = 15.1, fair hygiene: mean number of missing teeth = 12.41, and poor hygiene: mean number of missing teeth = 12.23.

Subjective appraisal of dental health was associated with quality of life. The better dental health subjectively appraised by the participants reflected the lower score of both severity and extent of the impacts.

In conclusion, although our research did not show a significant relationship between periodontal disease status and OHRQoL, we found a substantial relationship between teeth mobility and OHRQoL. This finding was confirmed through the prevalence, severity, and extent of impact as measures of OHRQoL, and the multiple regression model. Our findings also reported a significant relationship between tooth furcation and extent of impact on older people's OHRQoL. Thus, we underline the potential negative impact of advanced progression of chronic periodontitis on OHRQoL, such as increased tooth mobility and furcation involvement.

This study has some limitations as the study mainly focused on periodontal disease screening through the BPE examination and did not perform further examinations (such as clinical attachment loss (CAL) and radiographs assessment) to establish the diagnosis of periodontal disease mainly due to data collection time limitation. Furthermore, as a nature of a cross-sectional study, we cannot assess the causality relationship between periodontal disease (including other predictor variables) and OHRQoL. Thus, a longitudinal study is needed to provide a better understanding of the causality relationship between the predictors and OHRQoL.

To the best of our knowledge, this is the first study to assess the relationship between periodontal disease and OHRQoL in older people in Indonesia delivered at the population level. The other strength is that the study includes the assessment of participants' characteristics as predictors of the OHRQoL (demographic, socioeconomic, behavioural, systemic disease, and subjective appraisal of dental health).

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Author Contributions

M. Hijryana, contributed to conception and study design, data collection, data analysis and interpretation, drafted and critically revised the manuscript; M. MacDougall contributed to conception and study design, data interpretation, and critically revised the manuscript; N. Ariani contributed to the data collection and critically revised the manuscript; P Saksono contributed to data collection and critically revised the manuscript; L.S. Kusdhany contributed to data interpretation and critically revised the manuscript; A.W.G. Walls contributed to conception and study design, data interpretation, and critically revised the manuscript. All authors gave final approval and agree to be accountable for all aspects of the work.

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Tables

Table 1. Characteristics of the sample

Independent variables	Groups	n (%)	Mean (SD)	Range (Min-Max)
Demographic:				
Age	51-64 years	149 (41)	66.6	(54 – 92)
	65 years and above	214 (59)	(5.7)	
Gender	Male	115 (31.7)		
	Female	248 (68.3)		
Marital status	Single, divorced and widower	165 (45.5)		
	Married	198 (54.5)		
Socioeconomic:				
Educational background	Never attended formal school	29 (8)		
	Not completed elementary school	86 (23.7)		
	Elementary school	93 (25.6)		
	Junior high school	52 (14.3)		
	High school/vocational school	79 (21.8)		
	College/University	24 (6.6)		
Family income	Under the minimum wage (Up to Rp. 3.500.000)	241 (66.4)		
	More than minimum wage	117 (32.2)		
	Missing data*	5 (1.4)		
Behavioural:				
Smoking status	Never smoke	275 (75.8)		
	Former smoker	52 (14.3)		
	Active smoker	36 (9.9)		
Brushing habits	Brushing at least two times a day	344 (94.8)		
	Brushing less than two times a day	19 (5.2)		
Pattern of dental visit	Routine dental check-ups at least once a year	26 (7.2)		
	Not having routine dental check-ups	337 (92.8)		
Systemic disease:				
Diabetes status	No Diabetes	321 (88.4)		
	Diabetes	42 (11.6)		
Diabetes time duration				
	No diabetes	321 (88.4)		
	10 years and below	28 (7.7)		
	More than 10 years	14 (3.9)		
Oral health condition:				
DMF-T score	Very low - Low	36 (9.9)	17.6	(0 – 32)
	Moderate - High	327 (90.1)	(7.2)	
OHI-S	Good	21 (5.8)	3.3 (1.3)	(0 – 5.8)
	Fair	135 (37.2)		
	Poor	207 (57)		
Furcation status	Not having teeth with furcation involvement	205 (56.5)	0.8 (1.1)	(0-8)
	Having teeth with furcation involvement	158 (43.5)		

Mobility status	Physiological mobility Having teeth with increased mobility	134 (36.9) 229 (63.1)	3.04 (4.04)	(0-23)
Periodontal status	Not having chronic generalised periodontitis Having chronic generalised periodontitis	91 (25.1) 272 (74.9)		
Subjective appraisal of dental health	Very good and good Fair Bad and very bad	187 (51.5) 160 (44.1) 16 (4.4)		

*missing data were excluded from the severity and extent of the impact analyses

Table 2. Percentage and odds ratios of the prevalence of impact according to the periodontal condition.

Periodontal condition	**Prevalence of impact (fairly/very often)**			
	***n* (%)**	**Odds ratio (95% CI)**	**χ^2 *statistic***	***p-value***
Periodontal status				
Not having chronic generalised periodontitis	68 (74.7)	0.92 (0.54 – 1.59)	0.09	0.77
Having chronic generalised periodontitis	199 (73.2)			
Furcation status				
Not having teeth with furcation involvement	145 (70.7)	1.4 (0.87 – 2.26)	1.93	0.17
Having teeth with furcation involvement.	122 (77.2)			
Teeth mobility status				
Physiological mobility	88 (65.7)	1.87 (1.16 – 3.01)	6.78	0.009
Having teeth with increased mobility	179 (78.2)			

Table 3. Severity of the impact according to the predictor variables

Independent variables	N	Mean	Difference in means	95% CI for the difference in means	*p-value*	*Effect size*
Age groups						
50-64 years	149	11.54	-0.54	-2.06 – 0.98	0.485[a]	0.001[d]
65-years and above	214	12.08				
Gender						
Male	115	11.5	-0.54	-2.15 – 1.07	0.513[a]	0.001[d]
Female	248	12.03				
Marital status						
Single, divorced and widower	165	11.35	-0.94	-2.44 – 0.57	0.221[a]	0.004[d]
Married	198	12.29				
Family income						
Under the minimum wage (Up to Rp. 3.500.000)	241	12.01	0.68	-0.93 – 2.29	0.408[a]	0.002[d]
More than minimum wage	117	11.33				
Smoking status						
Never smoke*[1]	275	11.73	group 1 and 2: -0.55	groups 1 and 2: -3.14 – 2.03	0.839[c]	0.001[d]
Former smoker*[2]	52	12.22	group 1 and 3: -0.49	groups 1 and 3: -3.52 – 2.54		
Current smoker*[3]	36	12.29	group 2 and 3: 0.07	groups 2 and 3: -3.64 – 3.77		
Brushing habits						
Brushing at least two times a day	344	11.67	-3.64	-6.99 – 0.3	0.033[a]	0.013[d]
Brushing less than two times a day	19	15.32				
Pattern of dental visit						
Routine dental check-ups at least once a year	26	9.88	-2.13	-5.03 – 0.77	0.149[a]	0.006[d]
Not having a routine dental check-up	337	12.01				
Diabetes status						
No Diabetes	321	11.71	-1.31	-3.65 – 1.03	0.27[a]	0.003[d]
Diabetes	42	13.02				
DMF-T score						
Very low - Low	36	7.28	-5.09	-6.94 – -3.24	<0.001[a]	0.044[d]
Moderate – High	327	12.37				
Furcation status						
Not having teeth with furcation involvement	205	11.22	-1.48	-2.98 – 0.03	0.054[a]	0.01[d]
Having teeth with furcation involvement	158	12.7				
Mobility status						
Physiological mobility	134	9.99	-2.98	-4.50 – -1.45	<0.001[a]	0.04[d]
Having teeth with increased mobility	229	12.96				
Periodontal status						
Not having chronic generalised periodontitis	91	11.91	0.06	-1.66 – 1.80	0.94[a]	<0.001[d]
Having chronic generalised periodontitis	272	11.85				

Table 3 continued.

Independent variables	n	Mean	Difference in means	Median (Min-Max value)	*p-value*	*Effect size*
Educational background						
Never attended formal school*[1]	29	10.79	The range of mean difference: 0.07 – 1.43	12 (0 – 21)	0.91[b]	0.01[d]
Not completed elementary school*[2]	86	12.22		11 (0 – 36)		
Elementary school*[3]	93	11.821		11 (0 – 39)		
Junior high school*[4]	52	2.13		12 (2 – 31)		
High school/vocational school*[5]	79	12.06		11 (0 – 31)		
College/University*[6]	24	10.79		10 (0 – 34)		
Diabetes time duration						
No diabetes*[1]	321	11.71	The range of mean difference: 0.18 – 1.43	11 (0 – 39)	0.682[b]	0.003[d]
10 years and below*[2]	28	12.96		11 (2 – 36)		
More than 10 years*[3]	14	13.14		12 (2 -34)		
OHI-S score						
Good*[1]	21	11	The range of mean difference: 0.55 – 1.47	10 (3 – 24)	0.444[b]	0.001[d]
Fair*[2]	135	12.47		12 (0 – 32)		
Poor*[3]	207	11.55		11 (0 – 39)		
Subjective appraisal of dental health						
Very good and good*[1]	187	10.04	group 1 and 2: -3.54	9 (0 – 36)	< 0.001[b]	0.08[d]
Fair*[2]	160	13.58	group 1 and 3: -5.96	12 (0 – 34)		
Bad and very bad*[3]	16	16	group 2 and 3: -2.42	15 (3 – 39)		

[a] Independent samples t-test; [b] Kruskal-Wallis test; [c] One-way ANOVA F-test; [d] Eta Squared

Table 4. Extent of the impact according to the predictor variables

Independent variable	n	Median (Min-Max value)	Mean Ranks	*p-value*	Effect size *(r)*
Age groups					
50-64 years	149	1 (0 - 11)	173.84	0.206[a]	0.07[c]
65-years and above	214	2 (0 - 10)	187.68		
Gender					
Male	115	2 (0 - 7)	179.57	0.508[a]	-0.03[c]
Female	248	1 (0 - 11)	187.24		
Marital status					
Single, divorced and widower	165	1 (0 - 10)	179.98	0.733[a]	0.02[c]
Married	198	2 (0 - 11)	183.68		
Educational background					
Never attended formal school*[1]	29	2 (0 - 5)	185.95	0.105[b]	0.01[d]
Not completed elementary school*[2]	86	2 (0 - 10)	197.53		
Elementary school*[3]	93	1 (0 - 11)	182.66		
Junior high school*[4]	52	1 (0 - 7)	180.88		
High school/vocational school*[5]	79	2 (0 - 6)	180.51		
College/University*[6]	24	1 (0 - 8)	126.35		
Family income					
Under the minimum wage (Up to Rp. 3.500.000)	241	2 (0 - 11)	187.89	0.024[a]	-0.12[c]
More than minimum wage	117	1 (0 - 8)	162.21		

Table 4 continued.

Independent variable	n	Median (Min-Max value)	Mean Ranks	*p-value*	Effect size
Smoking status					
Never smoke*[1]	275	1 (0-11)	177	0.249[b]	0.002[d]
Former smoker*[2]	52	2 (0-7)	194.89		
Active smoker*[3]	36	2 (0-6)	201.57		
Brushing habits					
Brushing at least two times a day	344	1 (0 – 11)	178.65	0.008[a]	0.14[c]
Brushing less than two times a day	19	2 (0 – 8)	242.68		
Pattern of dental visit					
Routine dental check-ups at least once a year	26	1 (0 – 5)	143.23	0.046[a]	0.10[c]
Not having a routine dental check-up	337	1 (0 – 11)	184.99		
Diabetes status					
No Diabetes	321	1 (0-11)	179.19	0.15[a]	0.08[c]
Diabetes	42	2 (0-10)	203.44		
Diabetes time duration					
No diabetes	321	1 (0-11)	179.19	0.26[b]	0.002[d]
10 years and below	28	2 (0-10)	194.59		
More than 10 years	14	2 (0-8)	221.14		
DMF-T score					
Very low - Low	36	1 (0 – 4)	129.31	0.001[a]	0.17[c]
Moderate – High	327	2 (0 – 11)	187.8		
OHI-S score					
Good	21	1 (0 – 7)	176.62	0.97[b]	0.005[d]
Fair	135	2 (0 – 8)	182.43		
Poor	207	1 (0 – 11)	182.26		
Furcation status					
Not having teeth with furcation involvement	205	1 (0 – 8)	171.48	0.026[a]	0.12[c]
Having teeth with furcation involvement	158	2 (0 – 11)	195.65		
Mobility status					
Physiological mobility	134	1 (0 – 7)	159.15	0.001[a]	0.17[c]
Having teeth with increased mobility	229	2 (0 – 11)	195.37		
Periodontal status					
Not having chronic generalised periodontitis	91	1 (0 – 7)	182.05	0.996[a]	-0.0003[c]
Having chronic generalised periodontitis	272	1 (0 – 11)	181.98		
Subjective appraisal of dental health					
Very good and good*[1]	187	1 (0 – 10)	157.50	< 0.001[b]	0.06[d]
Fair*[2]	160	2 (0 – 8)	204.41		
Bad and very bad*[3]	16	3 (0 – 11	244.31		

[a] Mann-Whitney U test; [b] Kruskal Wallis ; [c] Rosenthal's *r*; [d]Eta Squared

Table 5. Multiple regression models of predictors variables on the total OHIP-14 scores (severity of the impact), with 95% bias-corrected and accelerated (BCa) confidence intervals.

Predictor variable	*Coefficient*	*p-value*	*BCa* 95% Confidence Interval	
			Lower	Upper
Model 1				
Periodontal status	-0.52	0.52	-2.00	1.16
Mobility status	2.87	0.002	1.36	4.33
Furcation status	0.87	0.247	-0.77	2.40
Model 2				
Periodontal status	-0.61	0.464	-2.17	1.12
Mobility status	2.62	0.005	1.07	4.00
Furcation status	0.62	0.411	-0.94	2.09
Age groups	0.53	0.51	-1.19	2.04
Gender	2.63	0.05	0.05	5.22
Marital status	1.17	0.134	-0.27	2.64
Educational background	0.3	0.311	-0.25	-0.96
Family income	-0.69	0.37	-2.02	0.72
Smoking status	1.03	0.166	-0.49	2.56
Brushing habits	2.64	0.184	-1.00	6.26
Pattern of dental visit	2.44	0.07	0.05	4.49
Diabetes status	2.09	0.598	-4.92	9.02
Diabetes time duration	-1.09	0.685	-5.8	3.95
Subjective appraisal of dental health	3.15	0.002	1.73	4.51
Model 3				
Periodontal status	-0.49	0.556	-2.33	1.29
Mobility status	2.17	0.01	0.46	3.66
Furcation status	0.62	0.436	-0.87	2.04
Age groups	0.32	0.7	-1.33	1.83
Gender	2.38	0.072	-0.22	4.97
Marital status	1.14	0.151	-0.23	2.49
Educational background	0.37	0.211	-0.17	1.03
Family income	-0.55	0.463	-1.875	0.96
Smoking status	0.9	0.231	-0.78	2.61
Brushing habits	2.75	0.161	-0.83	6.25
Pattern of dental visit	2.52	0.09	-0.44	5.49
Diabetes status	1.89	0.617	-5.25	9.46
Diabetes time duration	-1.03	0.685	-5.56	3.93
Subjective appraisal of dental health	3.06	0.002	1.73	4.44
DMF-T score	3.93	0.002	1.9	5.97
OHI-S	-0.08	0.884	-1.25	1.09

Note: $R^2 = 0.044$ for model 1; $R^2 = 0.139$ for model 2; $R^2 = 0.164$